Towards a simple, robust and predictable EU Emissions Trading Scheme

Benchmarks from concept to practice

Ir. J.A.J.V. (Vianney) Schyns
Manager Climate & Energy Efficiency
Utility Support Group
Utility provider for a.o. DSM and SABIC
Vianney.Schyns@usgbv.com

March 21, 2006

Executive summary

There is a strong and growing interest for benchmarks as tool for the allocation of allowances in the EU ETS (Emissions Trading Scheme). As an alternative for historical grandfathering, they are bound to improve the effectiveness and the competitiveness of the scheme.

This paper addresses benchmark based allocation, its implementation and how this fits with the requirements and the timetable of the Directive for the 2nd trading period.

The cornerstone is to apply the same benchmarks for incumbents as well as for new entrants. Only then the effectiveness is not undermined and the market operates as under auctioning; but without the detrimental effect on competitiveness. Investments to reduce emissions are stimulated unambiguously, thus including combined heat & power (CHP) and zero emission power plants. With confidence in the trading scheme, companies will invest.

The principles when establishing benchmarks are: they must be output related, they ignore secondary effects and reflect equal efforts between different activities. Keep it simple.

While allocation with benchmarks based on historical production will greatly improve the ETS, it will not eliminate competitive distortions when low emitters increase their production. The case of CHP: locally more emissions, totally less. This is not the exception but the rule. These distortions can be removed through ex-post adjustment based on actual production. Benchmarks and ex-post adjustment eliminate electricity windfall profits structurally and turn the length of trading periods into a non-issue.

How to get solid benchmark data and what is already available

Product	Data needed	Time needed	Mton CO_2/year
Electricity	Verified emissions 2005 and net-production of electricity and heat	4-5 months	1,185
Steel	Data for 5-7 benchmarks	4-5 months	300-350
Cement	Emission per ton clinker and per ton cement	4-5 months	200
Refineries	One benchmark	Few weeks	100-120
Major chemicals	About 20 benchmarks are available. Some additional ones are easily achievable	Available 1-2 months	100
Total	35-40 benchmarks provide 85%-90% coverage		**1,900-2,000**

The draft NAPs can be made with current methods or with estimated benchmarks and a reservation can state to change the allocations when the benchmarks are available.

The reservation could be phrased as follows:
"The intended allocation to each installation can be changed in consultation with other Member States and the EU Commission, with the objectives to improve the effectiveness and the predictability of the scheme, to minimise or eliminate electricity windfall profits while stimulating energy efficient technologies including combined heat and power, to avoid competitive distortions between same installations in different Member States and for the handling of small installations, for example with an annual emission below 25 kton CO_2".

Success is within grasp of the timetable for the 2nd trading period

March – April 2006	Setting up the organisation, provisional allocation
End June 2006	Submission provisional NAPs to EU Commission
May – September 2006	Second round of data collection
October – December 2006	Final allocation after check of EU Commission

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1. Introduction

There is a strong and growing interest for benchmarks as tool for the allocation of allowances in the EU ETS (Emissions Trading Scheme). As an alternative for historical grandfathering, they are bound to improve the effectiveness and the competitiveness of the scheme.

Allocation on the basis of benchmarks – also known as allocation with PSRs (Performance Standard Rates) or Performance Based Allocation – gives companies a clear signal to invest to reduce emissions[1] while unequal allocations to equal installations are avoided.

While allocation with benchmarks based on historical production will greatly improve the ETS, it will not eliminate competitive distortions because future production of individual operators may increase or decrease. These distortions can be removed through ex-post adjustment based on actual production. Benchmarks and ex-post adjustment eliminate electricity windfall profits[2] structurally and turn the length of trading periods into a non-issue[3].

A report[4] of an inquiry reviewing the EU ETS by McKinsey and Ecofys bears out the interest for benchmarks: 61% of all respondents and 61% of companies consider benchmarking feasible (81% for NGOs). In the opinion of government and industry experts such benchmarks need to be EU-wide[5], not national, to avoid competitive distortions and to provide for predictability in the Internal Market.

2. Aim of this paper

To implement benchmarks for the allocation of allowances, benchmarks and their framework need to be identified and defined. The purpose of this paper is to clarify:

- How many benchmarks or PSRs are needed for a good coverage of the EU ETS?
- What are cornerstones for the effective use of benchmarks?
- What are sound principles when establishing benchmarks?
- How to get solid benchmark data; how to manage targets and risks?
- How to fit & plan benchmarking within the Directive for the 2nd trading period 2008-2012?

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[1] A less recognised feature of PSR with ex-post adjustment is that an investment to reduce emissions will never be regretted. The reward is independent of the actual value of the PSR, which is important as a PSR will gradually become more stringent. After an emission reduction project a company either avoids purchases of allowances or can sell allowances or both. (see “Climate change challenges and the search for a sustainable policy”, page 11, V. Schyns, 21 June 2005).

[2] See for example “Options and consequences for the allocation of allowances to electricity producers”, V. Schyns, 21 December 2005.

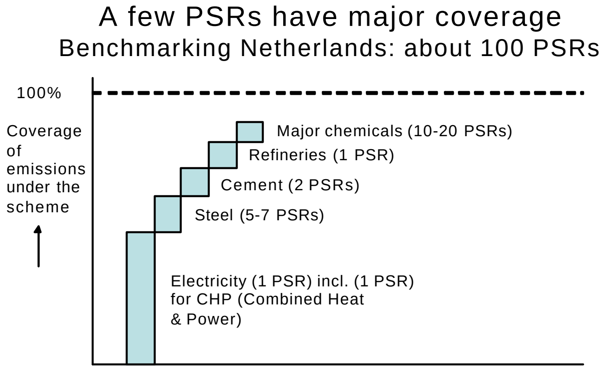
[3] See footnote 1 and V. Schyns, 21 June 2005, page 28-29; see also report of McKinsey and Ecofys (footnote 4) in which 40% of respondents wanted trading periods of 10 years and 50% more than 10 years. Long trading periods would however pose significant problems for new entrants’ reserves (Peter Zapfel, DG Environment, meeting of Centre for European Policy Studies, London, 7 July 2005).

[4] “Review of EU ETS, Survey Highlights”, November 2005, McKinsey & Company and Ecofys.

[5] Marcus Evans conference, London, 30-31 January 2006.

3. Needed benchmarks or PSRs for a good coverage of the EU ETS
A small number of benchmarks provides major coverage. This assertion is illustrated in the following picture:

In The Netherlands about 100 benchmarks were established in 1999-2000 according to the so-called worldtop (see appendix 1).



Benchmarks for the EU ETS need to be oriented to the weighted EU-average and the EU Best Practice. A limited number of benchmarks provides a significant coverage of emissions falling under the EU ETS in the 2nd trading period 2008-2012.

The worldtop is not suitable for the EU ETS: this would cause too great a shortage of allowances for one 5-year trading period.

4. Cornerstones for the effective use of benchmarks
For the effective use of benchmarks following cornerstones need to be set carefully:

- Same benchmarks for incumbents and new entrants; otherwise energy efficient and innovative technologies are not or insufficiently stimulated. This cornerstone eliminates the current need for transfer rules[6].
- No additional rules which maximise or minimise the number of allowances to operators vis-à-vis the benchmark; otherwise the effectiveness of the scheme for operators falling under such rules is nullified.
- The reserve for new entrants must be replenished when exhausted, for example by the elegant solution as applied in Germany[7]; otherwise innovative new plants would not be stimulated under any circumstances.
- Benchmarks can play a decisive role in removing the issue of electricity windfall profits by applying ex-post control on the production. This would enhance the credibility of the scheme.
- These cornerstones are for EU-wide application. It would already be great progress if a number of major emitting Member States take the lead.

The aim of these cornerstones is to create a simple, robust and predictable EU ETS. Only then the market functions as under auctioning, but without the detrimental effect to competitiveness. Investments to reduce emissions are stimulated unambiguously ,thus including combined heat & power (CHP) and zero emission power plants. With confidence in the trading scheme, companies will invest.

[6] Under transfer rules companies maintain the higher quantity of grandfathered allowances of a closed obsolete plant for a replacement plant for some time. Without such rules, replacement of an electricity plant is penalized; the loss of opportunity-cost is higher than the gain of lower fuel cost. However, transfer rules are in fact inadmissible; they create barriers to entry or cause a serious competitive distortion towards potential new entrants which have no obsolete plant to close.
[7] In an ex-ante scheme a new entrants' reserve is necessary; with ex-post control the new entrants' reserve is replaced by a contingency reserve to ensure the total cap. See also chapter 7.2.

5. Practical considerations

5.1 Practical considerations for ex-post control

To create an unambiguous trading scheme, it is recommended to apply ex-ante allocation with ex-post adjustments after each year. Following examples may serve as practical considerations to do so indeed:

- In many new Member States and Scandinavia district heating is applied to use waste heat. The involved installations fall under the EU ETS, in contrast with less energy efficient residential heating systems. Allowances based on historical emissions don't support investment in energy efficient district heating and lead to over-allocation in mild winters and under-allocation in severe winters. In the latter case the involved operators face a competitive distortion. The former poses risks to the integrity of the scheme. Ex-post control with benchmarks avoids these shortcomings.
- When many changes are occurring in a sector of a Member State, e.g. the electricity sector in Italy, historical emissions have a particular low significance for the future. New plants are started up and less efficient older ones on same or other sites are either closed, mothballed or operated at lower utilisation rates. Ex-post adjustment of the ex-ante allocation prevent complicated rules to judge whether a plant is closed (to withhold allowances); it prevents incorrect market signals and avoids competitive distortions between producers as well as the windfall profits, in this case, electricity.

5.2 Practical considerations for the establishment of benchmarks

Benchmarks will be of great importance for the functioning of the EU ETS, also as a blueprint for the global arena. As mentioned, there is a strong and growing interest for benchmarks. But it is asserted that "EU-wide benchmarking is not sufficiently matured allocation method to be used for the 2nd trading period. Member States may however find appropriate use for benchmarking at national level in certain sectors and for new entrants, e.g. in the electricity sector[8]." It is well known that the EU Commission would prefer benchmarking. What is nationally possible is also possible EU-wide or within a number of like-minded Member States. But benchmarks need action, they don't appear by themselves.

It is also said that there is insufficient agreement in industry on the definition and use of benchmarks, that therefore its introduction would be difficult. This is however a false argument in view of the experience with the allocations of the 1st trading period. For the 1st period historical reference data were collected, and the reference periods differed between Member States. At the time the whole industry did not agree either, but it happened, nevertheless.

Waiting for total agreement within industry for a particular allocation method would exclude any method. It is therefore practical to start with the establishment of benchmarks based on existing practice. Benchmark data exist and can be gathered just as historical emissions' data were gathered for the 1st trading period. This provides desired improvements of the EU ETS.

5.3 Practical consideration for the time needed to determine benchmarks

The draft NAPs can now be made with the current methods and a reservation can state to change the allocations when the benchmarks are available. This is elaborated in chapter 9.2. This is in line with the guidance note where it states that the EU Commission cannot accept amendments of NAPs after 31 December 2006 (see guidance page 3).

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[8] "Further Guidance on allocation plans for the 2008 to 2012 trading period of the EU Emissions Trading Scheme", Communication from the EU Commission, 21 December 2005.

6. Sound principles when establishing benchmarks

Benchmarks need to be established and used according to the following principles:

- Sound benchmarks are product (output) related.
- The system borders between production plants need to be the same.
- Benchmarks need to ignore corrections for secondary effects, keep it simple.
- The quality of benchmarks is primary a responsibility of producers.
- Benchmarks are determined by competent, independent consultants.
- Data quality, verification of benchmark data by competent authorities.
- The benchmark formula needs to fit with the EU ETS.
- Why using energy efficiency benchmarks and how to convert to CO_2-allowances.
- When using energy efficiency benchmarks, the use of electricity and heat needs to be calculated with the same standards for all production plants in a benchmark.
- Special circumstances need to be taken into account generically.

6.1 Product (output) related

Benchmarks are output related. They need to ignore factors such as technology applied or vintage of production plants. If not, the effectiveness of the scheme is undermined.

In real life, CEOs could not care less whether a plant with an obsolete technology is good in its kind; they want to know where they stand with their performance, no matter what technology or raw material they use.

6.2 System borders

The selection of system borders must be done in a correct way to make different plants comparable with each other. Competent independent consultants take care of that.

6.3 Ignore secondary effects – keep it simple

Often products are not fully homogeneous; therefore correction factors would need to be used. However, in general – for example bulk polymers – the effect of a different grade mix is of secondary importance.

Firstly, the effect of different grades (energy or emissions per grade) can be of secondary importance. Secondly, most producers have a comparable product grade mix to serve the market. If however a correction is justified, this correction must also be simple and straightforward.

A good example is the cement industry. A combination of two benchmarks suffices to grasp the first order differences between different production plants.

6.4 Responsibility for the quality of benchmarks – keep it simple

Certain benchmarks might be less well designed. In this case the established benchmarks should be used until a better benchmark is established.

A better benchmark is the primary responsibility of companies. This principle is applied in the Covenant Benchmarking in the Netherlands. Competent authorities identify possible weaknesses in benchmarks and ask companies to undertake action together with the competent consultant.

6.5 Benchmarks are determined by competent, independent consultants.
This principle is followed by the Covenant Benchmarking in the Netherlands. Many benchmarks are already running for a long time (for example benchmarks for steam crackers, refineries, polymers, etc.). Such consultants treat individual data confidentially and have the expertise and contacts to establish and maintain good quality benchmarks.

6.6 Data quality, verification of benchmark data by competent authorities
The quality of data of running benchmarks is equal or better than data of historical CO_2-emissions before 2005, in most cases. So there is no reason to refrain from using benchmark data for the 2nd trading period.

Benchmark data of companies must be verified by competent authorities. Therefore for each benchmark a simple protocol is needed with the rules of the game. The consultants can provide a protocol rather quickly. By starting with a limited number of benchmarks this is manageable.

6.7 Target setting needs to fit within the EU ETS to reflect equal efforts
Following benchmark formula will serve the purpose of avoiding competitive distortions, of achieving an effective trading scheme with unambiguous signals. It takes BAT into account in the potential of processes to near, equal or surpass BAT. BAT in this context means the <u>proven Best Practice in actual operation</u>[9], not a theoretical figure from literature.

- **Benchmark data: population of plants under the scheme**
  - Currently EU-25, in future with Norway, Canada, Japan, South Korea, etc.
  - Globally, an option is to apply different PSRs for different regions, e.g. EU-25, Americas (USA, Canada), China, India, etc. as a transition for 10-20 years.

- **PSR = WAE – CF x (WAE – BAT)**
  - WAE = Weighted Average Efficiency
  - BAT = Best Available Technique (the proven Best Practice)
  - CF = Compliance Factor, <u>equal</u> for all PSRs, reflecting equal efforts between different types of installations[10].

- **Compliance Factor**
  - 2008: CF = for example 3% to create a CO_2 market price

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[9] Single data are often not given by consultants due to confidentiality reasons. The average of about 4-5 best plants is justified. This is better from the point of view of equal efforts between different products when only 1-2 plants of a product made a technology breakthrough. Another example is when the best 1-2 plants have realised export of waste heat to district heating, while this is (yet) rather difficult for most plants of the same product. In conclusion, the efforts between different products are better balanced and innovative breakthrough plants are better stimulated.

[10] To maintain the principle of equal effort between PSR's, regular up-dating of a PSR is required. When the monitoring procedures under the ETS are fully in place, the update of a PSR can become an (bi-) annual routine.

- o 2012: possibly 15%-25%[11]
- o CF will be adjusted annually, for the years to come.

Observation: this allocation below EU-average statistically equals the average historical grandfathering in the EU with a general reduction factor.

Under ex-post control annual adjustment of the Compliance Factor takes into account:

1. A market price for allowances at a level, which encourages innovations and efficiency improvements[12]; this gives predictability for investors to reduce emissions.
2. Total industrial emissions and the long-term objective function for industrial emissions as established by the competent authorities.

In current practices, many Member States may auction allowances from the new entrants' reserve if a surplus emerges. This contradicts with the first point above; there is the risk of a price collapse when the economy grows less than expected. This risk is part of the current cap & trade implementation. PSR (benchmarking with ex-post) avoids this problem.

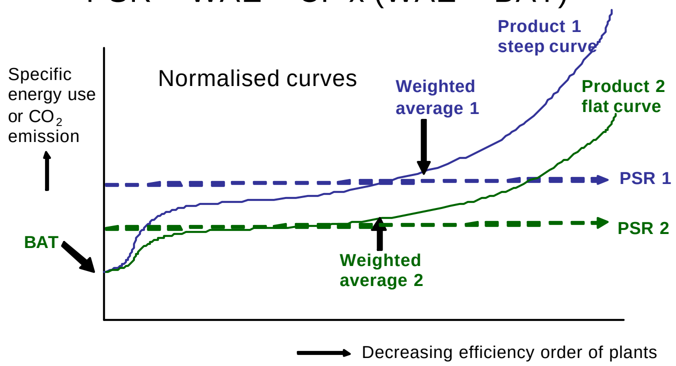
The formula takes account of different shapes of the efficiency curve for different products (the potential of processes in their path to BAT[13]):

Products with a steep curve have a higher potential to reduce emissions, products with a flatter curve have a lower potential.

In practice the BAT in this formula is not one single point, but the average of the best four to five production plants[14].

By gradually increasing the CF the demand on <u>all</u> products is increased. Nevertheless it should be noted that achieving BAT for an entire population of production plants takes a long time. During this time the BAT tends to improve. BAT is a moving target.

$$PSR = WAE – CF \times (WAE – BAT)$$



Plants with a favourable position on the curve (so left towards BAT) require usually a higher investment (more heat integration (air preheat, in-process heat exchangers, side reboilers on distillation columns), higher efficiency rotating equipment, etc.). Examples are energy efficient steamcrackers, refineries, clean coal power plants or production plants that capture waste heat for export to for example district heating. The additional investment is even higher when an existing plant can run (harvest strategy) and retrofits are needed for improvement.

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[11] The stringency of the CF is within the limits of lead-time to reduce emissions a political decision; it depends also on the efforts undertaken elsewhere in the world.

[12] To achieve a continuing downward trend of emissions a CO_2-price between € 30-50/ton is needed (Prof. Michael Grubb, Point Carbon conference 28 February – 1 March 2006, Copenhagen). At persistent low prices emissions' trading misses the point and important technologies, such as clean coal, cannot become competitive.

[13] Therefore PSR = BAT + x% or PSR = average efficiency – y% are both unjust.

[14] With this approach the efforts between different products is better balanced and the breakthrough plants are better stimulated.

A more favourable position on the curve can also be achieved with lower investments compared with the investment in conventional technologies. This can be achieved by the implementation of break-through technologies, of novel technological concepts. But this requires considerable risk-taking and investment in R&D for a long period (typically 15 years) in which the novel idea may fail. And even when an investment in a plant with a novel concept is decided, there are often costly infancy diseases which need thorough investigation and additional repair investments. And during this period the investment does not pay off.
The current practices to grant (relatively many) allowances to incumbents based on historical emissions and to grant (relatively few) allowances to new entrants (new plants) based on BAT or worse on "what they need" do not provide the additional incentive from the EU ETS to upgrade and innovate the entire production park.

The return on investment of upgrades by retrofits is often improved by smaller capacity extensions – capacity creep – but in various Member States thresholds (such as minimum 10% capacity increase) prevent to get additional allowances from the new entrants' reserve. In these cases the ETS does not stimulate efficiency and innovation, it even hinders.

In contrast, the proposed approach provides unambiguous signals to producers:

- Efficiency improvement will always be rewarded; the reward is independent of the actual value of the PSR in the future. The result of an investment to reduce emissions is either more sales or fewer purchases of allowances, or both. This feature removes the need for longer trading periods completely.
- It is also rewarding to improve BAT, good for competitiveness and the climate objective.

In short, installations are dynamic, not static. Under benchmarks, performance not the inner mysteries of an installation ensures the effectiveness of the ETS. It is up to the operators to invest or to purchase allowances.

Ex-post adjustment based on actual production shifts the cap to a region
Often a higher emission of an installation means a lower emission for the total population of production plants – for the total of the region. The famous example is combined heat and power (CHP), locally more but in total fewer emissions. This is not a unique phenomenon. The example of CHP is not the exception but the rule.

Any growth of more efficient producers – winners of market share – results in lower emissions. With ex-post adjustment of the production the overall cap is maintained, the cap of each installation is shifted to the region (the EU for the EU ETS).

6.8 Why using energy efficiency benchmarks

First of all many benchmarks are available based on energy efficiency. Energy efficiency corresponds with the policy to lower CO_2-emissions.

Secondly, as long as emissions' trading is only applied in the EU, benchmarks based on CO_2-emission per unit of product could cause undesired shipments of carbon rich fuels outside the EU to be replaced by natural gas. The same emissions will then occur outside the EU.

6.9 Taking account of electricity and heat in energy efficiency benchmarks

In case energy efficiency benchmarks are applied, uniform conversion factors for the use of heat and electricity must be used. Primary energy carriers need to be calculated according to one uniform heating value (high or low heating value (LHV), the latter is nearly always used).

This is the approach followed by consultants active in energy efficiency benchmarking; otherwise comparisons between processes are not on equal footing.

Following conversions are recommended:

- Electricity: 40% efficiency on enthalpy, therefore 3.6/40% = 9.0 GJ/MWh
- Heat: 90% efficiency on enthalpy
- Heating value primary energy: Lower Heating Value (LHV)

Other conversions can be applied; most often they have only a secondary effect on the final result. It remains important to use uniform values for the same products.

6.10 How to convert energy efficiency to CO_2-allowances

The conversion from energy efficiency to CO_2 is easy. The emissions trading in the EU ETS is a direct emission scheme. After each year allowances have to be surrendered equal to the realised direct emissions, meaning the emissions on site.

- **Allowances = RDE + RTE – (REE – PSR) x CCF**
    - RDE = Realised Direct Emissions
    - RTE = Realised Transferred Emissions
    - REE = Realised Energy Efficiency of the individual plant
    - CCF = CO_2 Conversion Factor of the marginal fuel

This formula can be applied ex-ante (based on historical emissions) with and without ex-post adjustment based on the actual production quantity. The latter, despite being a great step forward, would be only half of the solution for an effective scheme.

The marginal fuel is natural gas for many industrial processes and sites; then the CCF = 56.1 kton CO_2/PJ for “Groningen” quality natural gas (or 56.1 ton CO_2/TJ or 56.1 kg CO_2/GJ).

It is recommended to use one single CCF, the CCF of natural gas (only depending on the natural gas quality) for installations and sites which use energy efficiency benchmarks. There are often rest fuels and other fuels available on site and shipments outside the EU ETS geography do not contribute to lower emissions globally. In contrast with electricity producers, most industries cannot or hardly incorporate the cost of the CO_2-constraint caused by the use of more carbon rich fuels in the price of their products.

6.11 Transferred emissions when using energy efficiency benchmarks

When using energy efficiency benchmarks, transferred CO_2 is included in the allocation of allowances. An example is the sale of CO_2 by a refinery to greenhouse agriculture companies. As soon as such beneficial practices make inroads of any significance, the benchmark or PSR should be altered based on the same principles as the formula above. Taking away allowances when updating the allocation – the current practice – works counterproductive.

This approach can be followed for combustion and process emissions of all assigned sectors including electricity (the latter have no process emissions).

The chemical industry is an exception. In this industry some processes use CO_2 as a feedstock, notably urea and melamine. In such cases the realised direct emissions should be added with transferred CO_2 and feedstock use should be subtracted. Therefore PSR (benchmarks with ex-post adjustment) works best.

This approach may be relevant from 2013 onwards. Until that year process emissions from the chemical industry are outside the scope of the EU ETS. In case such investment projects are considered, it is recommended to offer the possibility of obtaining Joint Implementation credits or an opt-in as from 2013 with the assurance to get the credits for earlier abatement.

Another option of a more technical nature for the period until 2013 – requiring a political decision – is to offer the possibility of interchanging process emissions with combustion emissions in case of a CO_2 abatement project. This would bring chemical sites at equal footing with for example refinery sites for the same abatement investments.

6.12 How to deal with special circumstances

As argued, benchmarks should ignore secondary effects, keep it simple. If there are special circumstances any adjustment should be applied in a fundamental and generic way.

The leading principle should be an estimate of equal efforts between different activities and installations falling under the trading scheme. Two examples:

- The legal requirement of desulphurisation of fuels will cause higher energy use and higher emissions from refineries, not yet included in available benchmark data. The generic solution is an adequate adjustment of the benchmark.
- An opt-in for N_2O from nitric acid plants is now under consideration in a number of Member States. The companies have asked for one European benchmark and the involved Member States are determined to follow this approach. Historical benchmarks are available, but in this case a rapid reduction of emissions can be achieved, e.g. typically more than 2/3. Therefore a projected, extrapolated benchmark reflects equal efforts between different activities and installations.

7. How to get solid benchmark data and what is already available

7.1 Electricity

The electricity benchmark is the most important for the EU ETS because more than half of the emissions originate from this product. Great care is therefore required.

Unrestricted growth of coal-fired electricity is not feasible if carbon emissions need to be curbed. On the other hand, the use of coal and lignite is very important for the foreseeable future, say the next 100 years. Under present allocation rules, an improvement of energy efficiency of a marginal power plant will in general reduce the profit of all installations[15]; CHP is hardly stimulated. Present rules fail for zero emission power plants.

The alternative must therefore realise following objectives:

- Improvement of energy efficiency;
- The use of co-fired biomass;
- Zero emission power plants (such as clean coal);
- Where heat is needed, CHP to be applied.

One benchmark for electricity meets these objectives. With ex-post adjustment based on production windfall profits will be eliminated. A single benchmark for electricity does not put coal and lignite out of business. In the short term operators will recoup the cost of allowances in the market; in the longer term one benchmark makes zero emission plants profitable.

The benchmark for electricity is straightforward. A competent consultant can gather following data from each plant within 4-5 months (say from May 2006 to September 2006):

- The verified CO_2-emissions of 2005;
- The net-production of electricity of 2005 (so excluding own use of the power plant);
- The net-production of usefully applied exported heat[16] of 2005 (the case of CHP).

A consultant with subsidiaries in most Member States of the EU would fit well for this job. We recommend for consideration to exclude data collection below 50 MWe outputs of CHP. This production is then taken into account at a standard emission per MWh – 250 kg CO_2/MWh.

Key data

- Total emission of fossil-fuelled electricity in the EU-25 is estimated between 1,150-1,200 Mton CO_2/year.
- Number of power plants in EU-25: several 100 large scale plants, a greater number of large, medium and small scale CHP plants.
- Number of benchmarks: 2, one for electricity and one for heat (the heat benchmark: 90% efficiency based on natural gas for heat export from CHP, 63 kg CO_2/GJ, to be subtracted for the calculation of the electricity benchmark). CHP gets allowances based on these two benchmarks.

[15] The loss of opportunity-costs' revenues is higher than the gain of lower fuel costs.

[16] Data on exported heat, usually steam or hot water, need to be gathered on the quantity(kton/annum), the pressure and temperature in order to be able to apply the same energy (enthalpy) values to make the benchmarks comparable (for example enthalpy above 15 ^{o}C water). Data gathering of exported heat measured in GJs must be avoided because different companies use different enthalpy references.

7.2 Steel

In order to be able to set realistic targets for the steel sector, the activities on steel sites need to be broken down into comparable production plants (coke ovens, metal ore (including sulphide ore) roasting, sintering installations, pig iron from blast furnaces, steel, oxy steel, continuous casting, electric arc furnaces, etc.). The Verification Bureau Benchmarking in the Netherlands can provide hands-on experience about the method to determine benchmarks.

In the same way as for a chemical site, the production of each process is multiplied with the benchmark and added together to get the total benchmark energy use of the site. The total site benchmark energy use is then compared with the actual total site energy use.

Key data

- Total emission steel sector in the EU-25 is estimated at 300-350 Mton CO_2/year.
- Number of plants (steel sites) in EU-25: probably between 50 and 100.
- Number of benchmarks: in the order of 5-7.

7.3 Cement

Two benchmarks are effective in combination:

- Ton CO_2/ ton clinker
- Clinker to cement ratio

The cement industry has numerous data and will certainly be able to provide the EU-average and the EU Best Practice in a relatively short time, e.g. within a few months.

The EU-average is around 850-900 kg CO_2/ton clinker and around 750-800 kg CO_2/ton cement, therefore the clinker to cement ratio is about 85%. The EU Best Practices are about 800 kg CO_2/ton clinker and 600 kg CO_2/ton cement.

Key data

- Total emission cement sector in the EU-25 is estimated at about 200[17] Mton CO_2/year.
- Number of plants in EU-25: probably between 150 and 200.
- Number of benchmarks: 2.

[17] The cement production of the EU-15 was around 170 Mton/year in 1995. In 2004 the cement production was 280 mln ton in the EU-25 excluding Cyprus, Malta, Latvia, Lithuania, Slovakia plus Norway, Switzerland and Turkey.

7.4 Refineries

There is a running benchmark (for about 20 years) based on energy efficiency executed by Solomon Associates. This consultant located in Dallas can easily provide the data for the EU-average and the EU Best Practice in short notice (within a few weeks).

The energy efficiency of refineries is defined by the Energy Intensity Index (EII). An accurate indication of the relevant data is:

- Weighted Average Efficiency EU-25: EII = 80-81;
- Best Practice EU-25: EII = 55-63.

These data lead to the following target benchmarks:

EU bechmark data refineries							
Product	Consultant	Weighted EU average	EU Best Practice	Efficiency Electricity	Heat	PSR = WAE - CF x (WAE - BP) CF = Compliance Factor =	
Indicative data		WAE	BP			15%	20%
		EII	EII			EII	EII
Refineries (1)	Solomon Associates	80,5	59	37,5%	90%	**77,3**	**76,2**
1)	Solomon energy intensity index (EII)						

Key data

- Total emission of refineries in the EU-25 is estimated at 100-120 Mton CO_2/year.
- Number of plants in EU-25: probably between 150 and 200.
- Number of benchmarks: 1.

7.5 Major chemicals

For quite a few major chemicals running benchmarks have been executed for a great number of years. In 2005 following data were gathered, usually based on the performance in 2003:

	EU bechmark data major chemicals							
	Product	Consultant	Weighted EU average	EU Best Practice	Efficiencies Electricity	Heat	PSR = WAE - CF x (WAE - BP) CF = Compliance Factor =	
			WAE	BP			15%	20%
			GJ/ton	GJ/ton				
1	Steamcrackers (1)	Solomon Associates	144,8	107,8	37,5%	90%	**139,3**	**137,4**
2	Pyrolosis gasoline (pygas)	Process Design Centre	1,3	0,6	42%	90%	**1,2**	**1,2**
3	Benzene extraction	Process Design Centre	3,8	2,2	42%	90%	**3,6**	**3,5**
4	Butadiene	Solomon Associates	9,72	7,3	37,5%	90%	**9,4**	**9,2**
5	MTBE	Process Design Centre	1,9	1,06	42%	90%	**1,8**	**1,7**
6	ldPE (low density polyethylene)	Phillip Townsend Associates	8,53	5,96	42%	90%	**8,1**	**8,0**
7	hdPE (high density polyethylene)	Phillip Townsend Associates	5,43	3,14	42%	90%	**5,1**	**5,0**
8	PP (polypropylene)	Phillip Townsend Associates	3,56	2,27	42%	90%	**3,4**	**3,3**
9	EPDM (ethylene propylene rubber) (2)	Phillip Townsend Associates	32,22	28,0	42%	90%	**31,6**	**31,4**
10	PVC (polyvinyl chloride)	Process Design Centre	3,8	3,4	42%	90%	**3,7**	**3,7**
11	Nylon-6	Process Design Centre	10,0	5,71	42%	90%	**9,4**	**9,1**
12	Ammonia (3)	Plant Services International	13,13	7,23	40%	90%	**12,2**	**11,9**
13	Nitric acid	Process Design Centre	-0,12	-1,8	42%	90%	**-0,4**	**-0,5**
14	Fertiliser (Calcium Ammonium Nitrate	Process Design Centre	0,99	0,35	42%	90%	**0,9**	**0,9**
15	Urea	Plant Services International	5,06	3,06	42%	90%	**4,8**	**4,7**
16	Melamine (4)	Nexant	79,46	60,55	42%	90%	**76,6**	**75,7**
17	Caprolactam excl. cyclohexanon	Process Design Centre	8,7	-0,9	42%	90%	**7,3**	**6,8**
18	Acrylonitril (2)	Phillip Townsend Associates	-6,2	-8,3	42%	90%	**-6,5**	**-6,6**
19	Yeast	Process Design Centre	5,9	5,62	42%	90%	**5,9**	**5,8**

1) Solomon energy efficiency index (EEI) adjusted for supplemental feeds
2) WAE and BP are not EU but worldwide data (for confidentialilty reasons)
3) 20.67 GJ/ton feedstock energy (these process emissions fall outside the EU ETS)
4) These data include feedstock use which must be subtracted: 29.5 GJ/ton ammonia and 21.99 GJ/ton urea incl. ammonia use.
Typicals are: 3.2 ton urea and -0.9 ton ammonia, both per ton melamine. This gives WAE = 35.6 GJ/ton melamine and BP = 16.7 GJ/ton melamine.

These benchmarks cover already the majority of emissions of chemical sites. Similar benchmark data (or good estimates[18]) of additional major chemicals can likely be obtained as well at short notice: styrene, phenol, methanol, etc.

[18] One possibility is to use the “worldtop” as a basis, see next section about minor chemical products.

What to do with minor chemical products
In addition to the above mentioned major chemicals, most chemical sites produce also many chemical products with a minor impact on the energy efficiency of the total site. It is not practical to establish EU-wide benchmark data for these chemicals on short notice.

Therefore a default value needs to be taken, for example 98% of their recent efficiency. The default value to be used as from 2008 is a political decision.

Another approach is to grant allowances on the basis of the so-called "worldtop" as determined in the Netherlands or Flanders plus X% for the EU-average and worldtop + Y% for the EU Best Practice. The additions of X% and Y% should be judged by the Dutch or Belgium Verification Bureau to reflect equal efforts with the players of the major products with solid benchmarks. Anyhow, the effect of deviations from the concept of the benchmark formula is of minor importance on the target for the scheme as a whole.

In order to promote the development of more benchmarks, it could be considered to grant additional allowances (possibly from a special reserve) when companies prove (after for example one year) that their performance is better than benchmark as defined by the proposed formula.

Key data

- The total emission of (major) chemical sites in the EU-25 is estimated around 100 Mton CO_2/year (this also depends on whether CHP is within or outside the permit site).
- Steamcrackers and ammonia plants, both with their downstream plants (see benchmarks in the table above), most likely cover about 40%-50% of the energy use and the corresponding CO_2-emissions.
- Number of chemical sites with steamcrackers and/or ammonia in the EU-25: probably between 40 and 60. In addition, there are a great number of smaller chemical sites, which mostly need to be excluded from trading to keep the scheme manageable.
- Number of benchmarks: about 25 for a large coverage.

7.6 Why a Compliance Factor of 15%-20% is a reasonable target

The products from the sectors above require a minimum quantity of benchmarks – about 10 excluding chemicals and about 40 in total (see under 8.4.1). The covered emissions are about 1,900 Mton/year, which is > 85% of the total of 2,200 Mton/year of the EU ETS.

Electricity is the major product falling under the scheme. Therefore it is important to make a solid forecast of this sector to arrive at the required Compliance Factor (CF).

In 2007 the average emission of fossil-fuelled electricity within the EU-25 is estimated to be about 700 kg CO_2/MWh. The Best Practice is around 250 kg CO_2/MWh (CHP). By 2015 or some years earlier the Best Practice will be zero kg CO_2/MWh caused by zero emission power plants. The use of the presented PSR formula enables and encourages this development.

With a total annual consumption growth of 1.7%/year and assumptions on the growth of production from nuclear and renewables the CF can be calculated:

Forecast EU-25		2002		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Coal with BAU	MWe prod.	100.530	0,50%	86.027	86.457	86.889	87.324	87.760	88.199	88.640	89.083	89.529	89.976	90.426
Co-firing biomass penetration					1,0%	3,0%	5,0%	7,0%	9,0%	11,0%	13,0%	15,0%	18,0%	20,0%
Possible reduction co-firing biomass			Mton CO2	0,94	-7	-21	-36	-51	-65	-80	-95	-111	-133	-149
Co-firing biomass increase as from 2008					865	2.607	4.366	6.143	7.938	9.750	11.581	13.429	16.196	18.085
Normal coal & lignite excl. biomass				86.027	85.592	84.282	82.957	81.617	80.261	78.890	77.502	76.099	73.780	72.341
Gas incl. CHP		60.318	3,7%	90.753	94.110	97.592	101.203	104.948	108.831	112.858	117.034	121.364	125.854	130.511
Oil		20.106	0,3%	20.409	20.471	20.532	20.594	20.655	20.717	20.780	20.842	20.904	20.967	21.030
Subtotal fossil-fuelled electricity in MWe				**197.189**	**201.038**	**205.014**	**209.121**	**213.364**	**217.747**	**222.277**	**226.959**	**231.797**	**236.798**	**241.967**
Nuclear (Finland + capacity cree		107.232	0,50%	111.038	111.594	112.151	112.712	113.276	113.842	114.411	114.983	115.558	116.136	116.717
Renewables		43.563	3,0%	53.001	54.591	56.229	57.916	59.653	61.443	63.286	65.185	67.140	69.155	71.229
Other		3.351	0,0%	3.351	3.351	3.351	3.351	3.351	3.351	3.351	3.351	3.351	3.351	3.351
Total MWe production		**335.101**		**364.579**	**370.574**	**376.745**	**383.100**	**389.644**	**396.384**	**403.326**	**410.478**	**417.846**	**425.439**	**433.264**
Growth					1,64%	1,67%	1,69%	1,71%	1,73%	1,75%	1,77%	1,80%	1,82%	1,84%

				Second trading period					Third trading period				
		2002	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total MWe in fossil incl. biomass		180.954	197.189	201.038	205.014	209.121	213.364	217.747	222.277	226.959	231.797	236.798	241.967
Total TWh in fossil incl. biomass		**1.585**	**1.727**	**1.761**	**1.796**	**1.832**	**1.869**	**1.907**	**1.947**	**1.988**	**2.031**	**2.074**	**2.120**
BAT (Best Practice)	ton / MWh		**0,25**	**0,25**	**0,25**	**0,25**	**0,25**	**0,25**	**0,25**	**0**	**0**	**0**	**0**
WAE	ton / MWh		**0,69**	**BAT = Combined Heat & Power**						**BAT = Zero emission plants**			
CF (Compliance Factor)			0%	**4%**	**9%**	**15%**	**21%**	**27%**	**31%**	**22%**	**25%**	**28%**	**31%**
PSR = WAE - CF x (WAE - BAT)		**0,750**	**0,69**	**0,67**	**0,65**	**0,62**	**0,59**	**0,57**	**0,55**	**0,54**	**0,51**	**0,49**	**0,47**
Total cap = emission (Mton) of PSR		**1.189**	**1.185**	**1.177**	**1.161**	**1.137**	**1.111**	**1.084**	**1.072**	**1.064**	**1.045**	**1.024**	**1.003**
Reduction in Mton				**-8**	**-23**	**-48**	**-74**	**-101**	**-112**	**-121**	**-140**	**-160**	**-182**
Average trading period reduction in Mton/annum						**-51**					**-143**		

From this analysis a **CF of 15%** appears as a reasonable target for the second trading period. The average reduction for electricity production is in this calculation 51 Mton CO_2/year. This is then the reduction of the 2nd trading period on top of the reduction of the 1st trading period (estimated also at 50 Mton CO_2/year for electricity).

When the combined growth of the other sectors is higher than 1.7%/year a CF of 20% could be a good target. A CF of 20% versus 15% results in an extra abatement of about 25 Mton/year for electricity and about 40 Mton/year for all sectors together.

Note that the CF needs to be relaxed when zero emission power plants are acknowledged as best practice (in this calculation in 2014). Otherwise the reduction target for all sectors together would become unachievable within the timeframe of one trading period.

In this approach it is assumed and recommended that co-firing biomass in power plants is stimulated (which is currently not the case, allowances are lost when updating the historical reference period). It is a clear possibility to lower long cycle emissions of new and – important from a policy point of view – existing power plants. The penetration of co-firing biomass at the top of the table is just an example to show what impact this possibility can have. Under PSR the market will decide for the lowest cost options (CHP, biomass, zero emission plants).

8. Managing the targets and assessing associated risks

Managing the targets by the CF can be done with the two possibilities:

- Benchmarking with ex-ante allocation;
- Benchmarking with ex-post allocation – PSR[19].

8.1 Benchmarking with ex-ante allocation: a fixed total cap

With ex-ante allocation historical reference years must be taken for the production or the emission in case of energy efficiency benchmarks. Disadvantages of the ex-ante approach:

- Electricity windfall profits remain.
- Innovations are stalled; winners of market share must buy allowances (distortion!).
- The effectiveness of the scheme depends on exogenous factors: the growth of renewables, CHP and innovations. The cap for 2012 is fixed in 2005.

A bridge between ex-ante and ex-ante with ex-post control could be to use realised production or emission data of year X – 2 for the issue of allowances in year X. The CF is adjusted annually to achieve the desired total cap. However, windfall profits still remain. Distortions between winners and losers of market share are less and known after each year.

8.2 PSR: a fixed total cap by using a contingency

For a fixed total cap, a contingency reserve should be established; the CF is increased for example from 15% to 20%. Then this reserve is about 40 Mton/year or 200 Mton for the period (1.8%). After one year the contingency of that year is eliminated, either it was needed or not.

The contingency reserve should be reviewed annually, but only for future years[20] to maintain transparency in the market. This can be done after the emissions of the previous year are known – so after 1 May – and when the projections of growth for all sectors are updated.

After 1 May 2011 the CF can be adjusted for the last time in the 2nd trading period. This is then the CF for 2012. The remaining contingency reserve for both 2011 and 2012 is 40 Mton for, in total 80/5 = 16 Mton/year average or only 0.8% for the total trading period.

8.3 Associated risks with benchmarking and ex-ante allocation

If the economic growth is lower than expected and the availability of hydropower is higher than normal as well, the shortage in the market melts like snow under the sun. This may lead to very low CO_2-prices and hence lack of progress with the environmental objective.

8.4 Associated risks with PSR

Under PSR the targeted environmental outcome can be achieved as under ex-ante allocation. If the economic growth is lower and more hydropower is available, market scarcity and hence the price for allowances are maintained. PSR (so with ex-post) is recession proof.

PSR is effective throughout the economic cycle. PSR provides for a simple, robust and predictable EU ETS.

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[19] The concept of PSR (Performance Standard Rate) is ex-post, it is rate based.
[20] So the CF cannot be adjusted in a year for that same year.

9. Organisation, the requirements of the Directive and action plan

9.1 Organisation

Running a PSR based scheme requires an adequate organisational structure. Something like a "Climate Board" for the review and adjustment of the CF and the PSR is advisable. The Commission and the Member States will have to draw on all their ingenuity to develop a structure which is as light-footed as it should be effective.

9.2 Timetable of the Directive

Adopting benchmarks for the main products falling under the scheme can be done in about 5-7 calendar months from now. In practical terms the timetable of the Directive requires:

- Around mid April: public consultation of the draft NAP;
- At 30 June 2006 the draft NAP needs to be submitted to the EU Commission;
- At 30 September 2006 the EU Commission must decide about each draft NAP;
- At 31 December 2006 each Member State must decide about the final allocation.

This tight time schedule makes the introduction of EU-wide benchmarks not easy. However, provisions in the Directive are useful to win the needed extra time:

- ✓ *"For each trading period …, each Member State shall develop a national allocation plan stating the total quantity of allowances that it intends to allocate for that period and how it proposes to allocate them."* (Article 9, sub 1).
- ✓ *"The plan shall contain a list of the installations covered by this Directive with the quantities of allowances intended to be allocated to each."* (Annex III, criterion 10).

The key words are "intends" and "intended". The draft NAPs can therefore be made with a reservation and with a provisional allocation based on estimated benchmarks. The final benchmarks must be known before 31 December 2006, so around September or October.

The reservation could be phrased as follows:
"The intended allocation to each installation can be changed in consultation with other Member States and the EU Commission, with the objectives to improve the effectiveness and the predictability of the scheme, to minimise or eliminate electricity windfall profits while stimulating energy efficient technologies including combined heat and power, to avoid competitive distortions between same installations in different Member States and for the handling of small installations, for example with an annual emission below 25 kton CO_2".

9.3 PSR allocation in the light of the Directive

Many parties assume that if ex-post control of the production is desired a change of the Directive would be necessary. However, this view can be challenged with Article 9, sub 1, Annex III, sub 10 plus an alternative interpretation of Article 11 of the Directive:

"For the five-year period beginning 1 January 2008, and for each five-year subsequent period, each Member State shall decide upon the total quantity of allowances it will allocate for that period and initiate the process for the allocation of those allowances to the operator of each installation". The alternative interpretation is:

- The decision on the total allocation is made on the basis of production and emission forecasts (as also now) including a contingency reserve.
- Initiate the process of allowances means: operators get their allowances conditionally;
  - o The 1st condition is whether the production forecast is met.

- The 2nd condition is the future PSR; annual adjustments ensure the total cap.

9.4 Action plan

The importance of the use of benchmarks and the timetable of the Directive require that actions need to be undertaken soon. A practical approach is presented below.

9.4.1. Summary of needed benchmarks

For an effective scheme following benchmarks are needed for a large coverage:

Survey of benchmarks for a large coverage of the EU ETS (for ex-ante and/or ex-post)						
Product	Number of benchmarks	Remarks	Emission Mton CO2/year	Emission %	Number of sites Est.	%
Electricity, large scale	1	Electricity	1185	54%	350	2,8%
Incl. Combined Heat & Power	1	Plus Heat				
Large scale >50 Mwe					200	1,6%
Small scale <50MWe (1)					1300	10,4%
Steel	7		325	15%	75	0,6%
Cement	2		200	9%	175	1,4%
Refineries	1		125	6%	150	1,2%
Chemicals, large scale	25		50	2%	50	0,4%
Chemicals, smaller scale	Efficiency		50	2%	250	2,0%
Subtotal	**37**		**1935**	**88%**	**2550**	**20%**
Rest	Efficiency		265	12%	10000	80%
Total	**37**		**2200**	**100%**	**12550**	**100%**
Note: (1) Small scale CHP can be assessed lump sum, to minimise data collection						

9.4.2 Second round of data collection

Data collection based on the conventional approaches is now underway in the Member States. In order to be able to apply benchmarks, a second round of data collection needs to be undertaken. This embraces:

- Determination of benchmarks by a consultant (preferably one per product);
- Historical (for ex-ante) or realised (for ex-post) productions of 2005; in practical terms the following is recommended:
  - Historical production 2001 until and including 2005. For ex-post only 2005.
  - Projected development of the economy until 2012 according to macro economic forecasts of the Commission, ECB and OECD.

9.4.3 Organisation of data collection

To organise data collection a joint effort between the Member States and the Commission seems to recommend itself.

A two-layer organisation springs to mind: Steering Committee, Working Groups; the organisation to include the running authorities of the Member States.

9.4.4 Timetable within grasp

March – April 2006	**Setting up the organisation, provisional allocation**
End June 2006	**Submission provisional NAPs to EU Commission**
May – September 2006	**Second round of data collection**
October – December 2006	**Final allocation after check of EU Commission**

Appendix 1
Benchmarks determined in 1999/2000, Covenant Benchmarking, the Netherlands
Source: Verification Bureau covenant BM (in **bold**: annex I list EU Directive emissions trading)

Worldtop list of 31 processes with the method top 10% or average of the best region

1	**Cement**	11	PVC	21	Semi-conductors
2	EPDM	12	Nitric Acid	22	**Steamcrackers**
3	Yeast	13	**Refineries**	23	Air separation
4	**Glass furnaces**	14	Aluminium electrolysis	24	Polystyrene
5	HDPE	15	**Ammonia**	25	Styrene monomer
6	LDPE	16	Beer brewing	26	Salt (NaCl)
7	LLDPE	17	Beet sugar process	27	Rock wool
8	Melamine	18	Chlorine	28	Lubricant oil
9	Penicillin	19	**Electricity generation**	29	Potato starch
10	Polypropylene	20	Ethylene benzene	30	Wheat/corn starch
				31	Sugar pulp

Worldtop list of 67 processes with the Best Practice method (Best Practice +10%)

1	AC/ECH	40	Isopropyl alcohol
2	ACNI	41	KAS/fertiliser
3	Alcohol production	42	Kraton IR (rubber)
4	Aluminium foundry	43	Kraton SIS (rubber)
5	Anode plant	44	MCA
6	BDO	45	Methanol
7	Benzene extraction	46	MTBE
8	Benzene dealkylation	47	Sodium tri polyphosphate
9	Pyrolysis gasoline hydrogenation	48	Nitrate
10	Phenol via Toluene	49	Nylon
11	BR latex	**50**	**Oxy steel**
12	BTX hydrogenation	51	Packaging mill
13	Butane separation	**52**	**Paper and Board production**
14	Butadiene	53	Compressed air production
15	Caprolactam	54	PET
16	Butene	55	PO/TBA
17	Chelates	56	PTA
18	Cumene	57	Roasting + sulphur plant
19	Dimethylterephtalate	58	Sintering
20	DPP / Bisphenol A	59	Melting / foundry
21	**Electricity generation (CHP)**	60	SM/PO
22	Electrolysis	**61**	**Steel**
23	Engineering Polymers	**62**	**Steam production**
24	Epoxy resins	63	Teflon
25	ESBR	64	Tinning
26	Ethylene Glycol	65	Urea
27	Ethylene oxide	66	Hydrogen / CO (synthesis gas)
28	Expandable polystyrene	67	Zinc
29	**Fibreglass**		
30	Phosphorus		
31	Phosphoric acid		
32	Glycol ethers		
33	Hot strip mill		
34	Hot dip galvanising		
35	Hydraulic press		
36	Hydroxyethylcellulose		
37	Industrial Polyester Fibres		
38	**Iron making**		
39	Isoprene extraction		

Benchmarks and the Annex I activities of the EU Emissions Trading Scheme Author: Vianney Schyns, 16 December 2002		
Annex I activities, participants of the emissions trading system	Benchmarks determined in the Netherlands	
	Top 10% or region method	Best Practice method
Energy activities		
Combustion installations with thermal input > 20 MWth (except hazardous or municipal waste installations)		
▪ Electricity	**+**	
▪ Combined Heat & Power		**+**
▪ Steam production		**+**
▪ Ammonia	**+**	
▪ Steamcrackers	**+**	
▪ Methanol		**+**
Mineral oil refineries	**+**	
Coke ovens		**+**
Production and processing of ferrous metals		
Metal ore (including sulphide ore) roasting		**+**
Sintering installations		**+**
Pig iron		**+**
Steel		**+**
Oxy steel		**+**
Continuous casting		**+**
Mineral industry		
Cement clinker	**+**	
Lime	-	**-**
Glass manufacture	**+**	
Glass fibres		**+**
Ceramic products: roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain	**-**	**-**
Other activities mentioned in Annex I		
Pulp from timber	**-**	**-**
Pulp from other fibrous materials		**+**
Paper and board (different PSRs for different papers)		**+**
Benchmarks for other activities determined in the Netherlands		
About 80 for other activities, notably chemicals	**+**	**+**